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Basic Study

# Investigation of Acupuncture Effects on Vegetative Brain Centres Using Functional Magnetic Resonance Imaging

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【关键词】针刺；磁共振成像；脑干；穴，内关
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FMRI has been used to study acupuncture effects for more than 10 years now. Many investigators have shown activations and deactivations of cortical structures, mostly of the limbic system (amygdala, insula, cingular cortex) that were interpreted as a modulation of the limbic network [1, 2]. As some of these structures also coordinate vegetative functions, recently interest has grown in imaging vegetative brainstem centers [3].

Functional imaging of the brainstem bears various technical problems: brainstem nuclei are of a size close to the resolution limit of fMRI (-3 mm). Unlike in fMRI of the cerebral cortex, in the brainstem one has to overcome severe artifacts caused by pulsation of the basilar artery running anterior to the brainstem as well as by cerbrospinal fluid and by motion e.g. during swallowing.

One of the best investigated acupuncture points is Neiguan (PC 6) whose antiemetic effect could be confirmed in various studies and a recent meta-analysis[4]. This acupoint is suggested to modulate antiemesis through activation of the vegetative nervous system, which in case of the stomach would be transducted via the dorsal motor nucleus of the vagal nerve (DMV) and the nucleus of the solitary tract (NTS) in the brainstem [5,6].

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## 1 Material and Methods

### 1.1 Experimental design

The authors used a specially designed high resolution fMRI sequence to measure activations of brainstem nuclei under manual acupuncture of Neiguan (PC 6) in 3 subjects using a block design. The stimulation paradigm consisted of four blocks of needle twisting (30 s) each followed by a resting block without needle stimulation (90 s). To keep the baseline controlled, subjects had to follow a visual attention task in which they had to fixate a cross and press a button whenever the symbol changed. The acupuncture effect was assessed after each block by the subjective strength of the deqi sensation rated by the subject using a numeric rating scale (NRS) ranging from 1-100.

Prior to acupuncture stimulation the authors did a mapping of relevant brainstem nuclei by a simple motor paradigm: In a block design with three repetitions subjects were asked to alternately make grimaces, swallow and clench their yaws to activate the motor nuclei of the facial, ambiguous and trigeminal nerve, respectively.

### 1.2 fMRI sequences

Measurements were done with a Siemens Allegra MR-Scanner (Siemens, Erlangen, Germany) with a magnetic field strength of 3T equipped with a 4-channel head coil. The authors used a cardiac gated EPI (echo planar imaging) sequence with a TR of 4.5 s in a sparse sampling approach with an interscan

 

interval of 3 s. This was done to minimize T1 fluctuations due to heart rate variability. The resolution of the 96 point matrix with 60 slices was 2 mm × 2 mm × 1.5 mm and therewith fine enough to resolve brain stem nuclei. Pulse and respiration were measured for physiological noise correction of the images.

## 2 Results

During the motor paradigm all three brainstem nuclei (facial, ambiguus and trigeminal) could be localized, each in two of three subjects. During acupuncture stimulation the authors found an activation of a distinct area close to the lower boarder of the fourth ventricle in two of three subjects. It was situated at about the same level as the ambiguus nucleus and the authors think it could be the dorsal motor nucleus of the vagal nerve (DMV) as a comparison with anatomical images suggest (Fig.1).

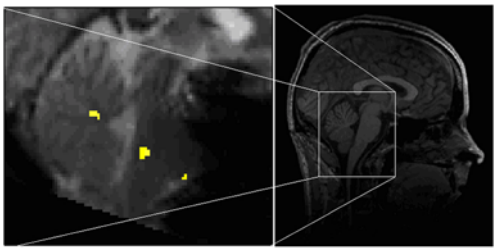

Fig.1. Brainstem activations during puncturing Neiguan (PC 6)

## 3 Discussion

This study shows that the method of fMRI can (under optimized technical conditions) reveal an activation of vegetative nuclei within the brainstem. The authors were for the first time able to show a possible activation of the DMV in fMRI during acupuncture treatment. The authors suggest that the antiemetic effect of Neiguan (PC 6) may in some part be mediated through the parasympathetic nervous system via the vagal nerve. This assumption is consistent with previous findings of other groups who could demonstrate a change in gastric motility measured by electrogastrography (EGG) after acupuncture treatment of Neiguan (PC 6) [5] as well as histological changes in the NTS and DMV in animal experiments of anti-emesis [6].

## References

[1] HUI KK, LIU J, Marina O, et al. The Integrated Response of the Human Cerebro-cerebellar and Limbic Systems to Acupuncture Stimulation at ST 36 as Evidenced by fMRI. Neuroimage, 2005, 27(3): 479-496.

[2] FANG J, JIN Z, WANG Y, et al. The Salient Characteristics of the Central Effects of Acupuncture Needling: Limbic-paralimbic-neocortical Network Modulation. Hum Brain Mapp, 2008 Jun 20 (Epub ahead of print).

**[3]** Napadow V, Dhond R, Conti G, et al. Brain Correlates of Autonomic Modulation: Combining Heart Rate Variability with fMRI. Neuroimage, 2008, 42(1): 169-177.

[4] Ezzo J, Streitberger K, Schneider A. Cochrane Systematic Reviews Examine P6 Acupuncture-point Stimulation for Nausea and Vomiting. J Altern Complement Med, 2006, 12(5): 489-495.

[5] LIN X, LIANG J, REN J, et al. Electrical Stimulation of Acupuncture Points Enhances Gastric Myoelectrical Activity in Humans. Am J Gastroenterol, 1997, 92(9): 1527-1530.

[6] WANG JJ, LIU XD, QIN M, et al. Electro-acupuncture of Tsusanli and Shangchuhsu Regulates Gastric Activity Possibly Through Mediation of the Vagus-solotary Complex. Hepatogastroenterology, 2007, 54(78): 1862-1867.

**● Short Report ●**

## How to Diagnose the State of a Dynamic System

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When analyzing a system, it is not only the easily quantified parameters (like where an item, e.g. the location of a planet in the planetary system or the weight, the temperature, and the blood pressure of a patient), but also the instantaneous changes of these parameters (e.g. the speed which is, of course, the magnitude of the instantaneous change of the location or even the acceleration which is the magnitude of the instantaneous change of the speed) that are crucial for determining its future development. While Newton observed 300 years ago that just knowing the mass, the location, and the speed of two celestial bodies in a 2-body system at some given moment suffices to predict its future, these simple and absolutely basic ideas seem not yet to have found full recognition in medical analysis and diagnostics. However, investigations by Johannes Greten seem to suggest that the situation (for Westerners sometimes weird looking vocabularies and concepts in traditional Chinese medicine) seems to be heading for exactly this. Thus, as a perfectly ignorant mathematician, I would like to discuss this aspect of "clinical dynamics" that clearly needs to be taken care of in any attempt of developing (Western or Eastern) clinical ontology, using sort of Newton's conceptual set-up to harmonies Aristotelean and Heraklitian thinking.

 